The Use of additional GPS Frequencies to Independently Determine Tropospheric Water Vapor Profiles

B.M.Herman, D. Feng and D. E. Flittner
Institute of Atmospheric Physics
University of Arizona
Tuscon, AZ 85721

E.R.Kursinski
Jet Propulsion Laboratory
California Insititute of Technology
Pasadena, CA 91109

It is well known that the currently employed L1 and L2 GPS/MET frequencies (1.2 - 1.6) Ghz) do not allow for the separation of water vapor and density (or temperature) from active microwave occultation measurements in regions of the troposphere warmer than 240 K Therefore, additional information must be used, from other types of measurements and weather analyses, to recover water vapor (and temperature) profiles. Thus in data sparse regions, these inferred profiles can be subject to larger errors than would result in data rich regions. The use of properly selected additional GPS frequencies enables a direct, independent measurement of the absorption associated with the water vapor profile, which may then be used in the standard GPS/MET retrievals to obtain a more accurate determination of atmospheric temperature throughout the water vapor layer. This study looks at the use of microwave crosslinks in the region of the 22 Ghz water vapor absorption line for this purpose. An added advantage of using 22 Ghz frequencies is that they are only negligibly affected by the ionosphere in contrast to the large effect at the GPS frequencies. The retrieval algorithm uses both amplitude and phase measurements to obtain profiles of amtospheric pressure, temperature and water water vapor pressure with a vertical resolution of 1 km or better. This technique also provides the cloud liquid water content along the ray path, which is in itself an important element in climate monitoring. Advantages of this method include the ability to make measurements in the presence of clouds and the use of techniques and technology proven through the GPS/MET experiment and several of NASA's planetary exploration missions. Simulations demonstrating this method will be presented for both clear and cloudy sky conditions.